NAVAL POSTGRADUATE SCHOOL
Monterey, California

EC 3550 MIDTERM EXAM II 11/96 Prof. Powers

- This exam is open book and notes.
- There are three problems; each is equally weighted.
- Partial credit will be given; be sure to do some work on each problem.
- Be *sure* to include units in your answers.
- Please circle or underline your answers.
- Do *NOT* do any work on this sheet.
- Show ALL work.

1	
2	
3	
Total	

Name: _____

1. A photodide has a quantum efficiency of 80% at an operating wavelength of 1300 nm. The dark current of this detector is negligible.

   (a) Calculate the incident optical power that will make the signal-dependent shot noise into a bandwidth of 400 MHz equal to one-hundreth of the thermal noise associated with a load resistance of 500 Ω at a noise temperature of 350K.

   (b) Calulate the signal-to-noise ratio (in dB) for the power level that you calculated in the prior part of this problem.

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2. An officer wants to design a short-distance data link that will work at 1 Gb/s. She thinks that she can use a commercial LED that has a capacitance of 500 pF and a carrier lifetime of 100 ps. Find the peak value of the drive current pulse that is required to achieve the desired data rate with this LED. (Note: the relation between a device's bandwidth, B, and its rise time, t_r, is $B = 0.7/t_r$.)

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3. Consider a surface-emitting LED with a emission-region diameter of 100 μm. The 3-dB power points in its symmetric emission pattern occur at an angle of 45° off the propagation axis. The index of refraction of the emitter material is 3.2. Light from this LED is to be coupled from the emitter into a small air gap and, then, into the fiber core. The fiber is a step-index 62.5/125 fiber with an NA of 0.18 and a core index of refraction of 1.45.

   Find the coupling efficiency *in dB*.